Understanding situated energy values in rural Kenya

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Off-grid energy systems are facilitating new forms of energy production and consumption. Independent from national grids, they can be installed in more ad-hoc ways and have the potential to generate profit not only by selling energy but also by collecting data about their users and environment. As such, they present new challenges and opportunities for the design of services and interactive systems, which require new understanding of what is relevant to the diversity of people who rely on these systems for power. In this paper, we report on an interview and probe-based study carried out in a rural area in Kenya. The study looks at personal energy narratives as well as the way people value appliances and energy-related services. It reveals how values influence perception of energy needs, the blurry boundaries between business and home contexts, and how widespread narratives of profit creation based on appliances may conflict with communal interests and aspirations of energy users.

Electric mini-grid; rural electrification; business development; understanding people

1 Introduction

An increasing number of companies are starting to provide "off-grid" energy solutions for those who have no access or decide to remain outside national energy networks. One way of doing this is through mini-grids, a form of off-grid system that involves small-scale electricity generation (10 kW to 10MW), often powered by diesel or solar energy, and which serves a limited number of consumers. Mini-grids can collect real-time data through individual meters and provide a detailed description of customers' energy use and payment patterns. The small and more flexible scale of mini-grids, combined with data gathering capabilities and increasing connectivity via accessible mobile phone networks, digitalisation of devices, and new possibilities for distribution, provide new challenges and opportunities for the design of energy applications and services.

This study focused on understanding the needs and values of people who are directly or indirectly affected by mini-grid services, particularly focusing on a specific rural area in Kenya. The study was part of an 8-month UK-based project to understand how value is and could be created through

energy data in developing countries. It was carried out in partnership with Steama.co a technology company that provides remote management and monitoring of off-grid energy services. Although Steama.co's current business revolves around technology, the company retains direct management of a number of mini-grids in Kenya, which were established as test beds for experimentation on social and technological aspects of future energy access and services. The company was interested in understanding the community in order to provide new services and balance supply and demand of its mini-grids. In particular, they wanted to a) design flexible tariff services for different users, b) consider opportunities to finance new services and appliances for their customers, c) understand how these appliances and services could help people develop energy-based businesses, and d) support financing of further mini-grid developments.

Steama.co's interests were in line with development programmes that focus on ways to increase use of energy and the types of energy available (Hanna & Oliva, 2015). Energy provision is widely considered essential for economic growth (UN Resolution, 2015). Consumption, however, is often regarded linearly, based on models of western developed countries. Energy studies tend to look at how people progress up an energy ladder (e.g. Kammen, 2015), moving from biomass to cleaner and more efficient fuels and acquiring appliances that rely on electricity (van der Kroon et al., 2013). There is a general assumption that more energy consumption is intrinsically positive. As in technology for development discourses (Bidwell, 2016; Turner, 2015), these ideas are strongly influenced by pre-conceived Western models and values, which can potentially limit exploration. We argue that the metaphor of linear progression of consumption, which starts from no consumption and moves towards a reproduction pattern of developed contexts, limits design exploration. Rather than looking at multiple aspects of energy in use, possibly leading to the consideration of radically new systems, the linear progression limits exploration and locks imaginaries into established outcomes.

Furthermore, this narrative bias may compromise studies, as it influences surveys and provide a specific framework for interpretation of trends. Inspired by research that looks at energy usage in practice (Bidwell 2013; Shove & Walker, 2014; Pink et al., 2017), mostly in developed contexts, we set off to understand how energy is situated in the lives of people with little access to it, considering histories and expectations towards the future. In particular, we aimed to understand how people in a rural area in western Kenya perceive their energy consumption, how they create personal and business value around appliances and energy-related services, both within and beyond monetary transactions. As presented by Pink et al. (2017) value is highly situated and does not necessarily correlate to how much energy is consumed.

Our study also attempted to balance time and resources available. Resources restricted the study to two 3-4 day visits, which eliminated the possibility of long-term ethnographic research. In Design, cultural probes (Gaver et al. 1999) are often employed to remotely gain insights from groups. In line with current critique of the use of probes in developing contexts (Soro et al., 2016), we opted for a mix of interview and probe-based approaches. The mixed approach allowed us to engage with a diverse group, revealing blurry boundaries between home and business, as well as how individual values influenced perceptions of energy needs, and how widespread narratives of profit creation based on appliances may conflict with communal interests and aspirations of energy users.

2 Related Work

Related work can be situated in thematic areas such as energy infrastructure, usage and consumption; design for development; and alternative "research for design" methods.

Over the last decades, researchers in the social sciences have widely employed qualitative methods to understand energy usage in the home (Shove, 2003; Wilhite, 2005; Henning 2006; Nader 2006). More recently, Shove & Walker (2014) have analysed energy supply and demand as part of the reproduction of bundles and complexities of social practice. Kuijer & Watson (2017) looked at historic developments of energy usage in the UK, and Pink (2011) investigated multisensoriality as

part of an agenda for doing ethnography of domestic energy consumption practices. Research on energy consumption in developing contexts, as mentioned above, is widely focused on direct applications rather than more complex values involved. Exceptions include work by Bidwell et al. (2013) which looked at how the practice of walking to the charging station in South Africa connected routines in using, storing, sharing and sustaining resources, and contributed to aspects of sociality, social order and perspectives on sustainability.

In HCI and Interaction Design, most research on energy perception and use has focused on energy-abundant and wealthy contexts, as criticised by Dillahunt et al. (2009). Several studies have attempted to understand people's perceptions of energy consumption based on the assumption that providing more information would lead to more sustainable attitudes (e.g. Fitzpatrick & Smith, 2009). However, the impact of knowing one's energy consumption has been debated (e.g. by Nilsson et al, 2014; He et al. 2010; Pierce et al. 2010; Buchanan et al. 2015), and recent work has focused on other ways to engage participants, exploring new formats for communication including objects (Broms, 2010), games (Gamberini et al, 2011), apps (Hasselqvist, 2016), and visualisations (Selvefors et al 2013). Through a series of prototypes, Simm et al. (2015) have attempted to create more tangible relationships between people and energy. Dillahunt & Mankoff (2014) have investigated the impact of social engagement techniques, e.g. neighbourhood as a means to encourage energy conservation.

There has been little exploration on interaction with energy data in developing countries, with tangential exceptions (e.g. Zamora, 2016). Recent literature on interaction design and HCI for development, as reviewed by Dell & Kumar (2016), is highly focused on thematic areas such as education, access (especially to Internet), and health, and on the use of mobile devices. There have been many examples of projects focused on communicating information (Wyche & Murphy, 2016) in areas such as agricultural advice (Knoche et al. 2015), market prices (Wyche & Steinfield, 2016) and health advice (Perrier et al. 2015).

Development has been a central theme in design, particularly since Papanek's publication of Design for the Real World (1984). Bonsiepe (1977) classically envisioned design practice "in the periphery" influencing design schools in countries such as India (NID) and Brazil (ESDI). De Laet & Mol (2000) also famously pointed to the importance of a deep understanding of values, traditions and rituals, as well as the need to integrate these values in the design of a system, e.g. through participatory methods. Through a design anthropology perspective, Pink et al. (2017) have investigated energy practices in the home, in developed and developing countries, pointing out how energy infrastructures are implicated in changing configurations of everyday contingencies, inviting designs and interventions that are equally contingent and contextual.

Indeed research for design has largely moved from traditional methods of surveys and questionnaires to ethnography-based approaches. Given the often-limited resources for research, probe-based methods that allow researchers to collect data with limited or no face-to-face interaction have become increasingly popular. "Cultural Probes" (Gaver et al., 1999) became particularly well-established, with many design researchers extending the method, e.g. to explore nuanced notions of subjectivity and intimacy (Wallace et al. 2013), or to consider artefacts as probes to understand a particular issue (Hutchinson et al. 2003). Soro et al (2016), however, demonstrated problems with applying probes in developing contexts, suggesting a dialogical approach instead, which strongly relates to the approach developed in this study. Traditional methods of personas have been identified as particularly problematic in this context as they provide an image of people that is skewed by the view of those defining the fictitious characters (Cabrero et al., 2016).

Our work contributes to current literature by providing an example of an application of dialogical probe approach to understand a contextual scenario of energy use. It is important to note that rather than focusing on energy conservation and sustainability, the study was framed within the context of business development or, more specifically, on appliance-based business development.

3 The study

The study took place in three villages in Mageta, a 8km-long island in Lake Victoria, Kenya. The first village, Mahanga Beach, was the main location of the study and where the mini-grid was installed. It is more densely settled and has more energy-consuming businesses than the other villages. The other two, Wakawaka and Kamongo, had no central power source at the time of the study, but individual homes and small businesses had their own solar panels.

The main economic activity in the island is fishing. Energy-consuming businesses in Mageta are largely owned and frequented by men. High among these businesses are video halls and barber shops. Women's businesses are primarily food-based, while a few also have small shops or sell goods. The Mageta mini-grid can host up to 68 lines with a maximum output of 6kW. More than half of these lines are currently active and provide power to a combination of homes and businesses. As a small fishing community on an island with a population of approximately 4000 people, even the largest businesses rarely consume more than 5-6kWh per day.

The study was carried out in two visits. Both visits were arranged by the partner company, who facilitated the logistics and contacts. Visits took place over three and four days, respectively, with two months' gap between the first and second visit.

On both visits, we were accompanied by a field operative and the site agent of the partner company. These individuals explained the history and current issues surrounding the mini-grid, introduced us to key members of the community, set up the interviews and probe-based activities, and hosted our entire visit, from coordinating accommodation and meals to providing translation and explanations where necessary. Most of the research was carried out in English, but where participants felt more comfortable speaking Luo or Swahili, translation was provided.

Figure 1. Barber shop and mobile phone charging services in Mahanga beach, Mageta Island, Kenya

3.1 First Visit

The purpose of the first visit was to understand Steama.co customers' relationships with energy. Semi-structured interviews were carried out with nine existing customers and one potential customer of the partner company, all of whom were business owners. Eight were males and two were females. Each interview took about one hour. Participants were selected by the field operative and the site agent based on accessibility, availability, willingness to participate in an interview, ease of communication, and relatively substantial power use primarily for business purposes.

Interview locations were indoors and outdoors, in energy users' homes and places of work. The interviews were documented on paper with marker, in a combination of notes and images, so that participants could see how the information they provided was being recorded.

Participants' lives and experiences were investigated along the following themes:

- Family - structure, number of members
- Business(es) owned and managed - type of business, products/services offered, income and family expenses
- Energy uses in the home and business
- Experience and challenges with energy access and the company managing the mini-grid
- Aspirations for the future - if they had more / better access to energy, kinds of business they would like to develop

3.1.1 Interview insights

All interview participants managed their own businesses, and almost all had multiple sources of income. Businesses included various kinds of shops selling mobile phones, accessories, cold drinks, clothing, etc.; cafes and bars; entertainment venues such as pool halls and video halls; and services including phone charging, haircutting, music downloading, and mobile money (M-Pesa).

The mini-grid served a variety of homes and businesses, although on the first visit we only spoke with people using the mini-grid for business purposes. Their businesses used power for lighting, music (to attract customers to their shop as well as to power their entertainment venues), and various electrical devices, from refrigerators for cold drinks to computers for music downloading to rows of power strips for phone charging. Almost every participant had dimensions of their business that relied on power and other dimensions that did not. They also had aspirations for expanding their businesses that were both energy-dependent and energy-independent.

For example, F.O., a barber, was using electric razors completely dependent on the mini-grid, but had slowly transitioned from fishing to running the barber shop before committing himself completely to the barber shop. He intended to open another shop in another location as well as to buy solar panels for charging wet cell batteries. S.A., one of the more prominent small business owners in the community, was running a video hall that relied on power, but he also sold mobile phones and accessories and operated a motorcycle taxi around the island. Another major businessman, E.O., had significant income from charging phones and music downloading, but he also managed a pool hall, sold high-end (relative to local income) mobile phones, and aspired to own a disco and a boutique selling clothes and jewellery as well as invest in a public service vehicle cooperative. N.O., the owner of one of the largest shops - and the only shop with not only one but two deep freezers (used as refrigerators) - had started out as a hawker, selling goods on the streets. Eventually he earned enough money to set up his own shop. When power first came to the island, he was sceptical - "At that time I was not prepared for that power. In my mind - what I can use for that power?" Then he got the idea to purchase a deep freezer to sell cold drinks and he thought, "Yes, this is the thing that will give me work," despite the fact that, "People were shocked. They didn't know if this thing could bring this power." His future plans were to "have a big shop" selling clothes and shoes, because no one on the island was selling good quality clothes.

Figure 2. Interviews

A number of businesses arose from or were defined by the context. Music and other downloading services were provided by people who had computers and collected various digital files from off the island and transferred them to people's phones or other devices on a pay-per-item basis. People seemed not to be aware of the ability to transfer digital files via Bluetooth. Since most people did not have power in their homes, the video halls played films throughout the day on a pay-per-view basis. Equally, businesses offered phone charging on a pay-per-charge basis.

When we discussed future business development opportunities, some people thought that if the island had a more reliable and larger source of power, many people would come up with new business ideas: "People have so many ideas that they have not said," said S.A. F.O., the barber, concurred: "It would be good if people had that power. If everybody has power, more people would engage themselves in business." This vision, however, was challenged in the second visit, where we interviewed people who were not customers of the partner company. "They say if you use more energy you make more money. I say no. You pay more to the power company. You may get more money, but no profit."

Most participants separated their business and personal financial management to some degree, but personal expenses and financial management issues could significantly impact on their businesses. For example, R.A., a female who had a TV for her customers' entertainment in her shop, kept her electricity account balance very low so that her partner could not watch TV alone in the shop at night and run her account dry. She said, "If I buy more power, someone else can use it and waste it. I want to use power only for business." N.O., the shop owner, said that unexpected illnesses could mean that he would occasionally have to use money that he was planning to reinvest in stocking his shop to take care of his family. He had developed a tactic of keeping a blue plastic cup to safeguard his earnings from selling cold water. Every earning and every expense related to selling water went into and came out of the cup, and he refused to touch that money for any other reason. Through this 'savings account', he was able to purchase a second refrigerator within six months of purchasing his first one. S.A. summed up most people's experience: "Always there is a problem with finances. What you have is less than what you expect or you are spending."

Participants also mentioned desire to access loans to expand their business. Some were able to get loans through the local cooperative of businesses or from a microfinance institution, but many mentioned they could not get capital. G.O., an older and more educated business owner, was the

only person who mentioned getting a loan from the bank. E.O.O. had taken a loan for a music system that he rented out for special occasions, but he was having difficulty paying off the loan, and he had to do other work in order to make the payments. Most participants described saving small amounts slowly over time, often keeping a balance in their mobile money account (M-Pesa).

When asked about their relationships to the partner company, participants expressed a mix of satisfaction with the service at various times and frustration at others, largely dependent on the capacity of the mini-grid. Participants were relatively dissatisfied with the way the company communicated energy usage. They received a notification when their balance was running low and a text message when they added credit to their account that told them how much credit they had added and what their new balance was. Some people kept careful track of their account, such as E.O., who said, "I normally know how much I am using in a day. The day I pay less I will check my balance more regularly to make sure my power will not go off." Others simply did not understand their power usage: "How come today I topped up 100 KES (Kenyan shillings, £1) and it has not taken me the way it usually does?" asked R.A. Some participants were on a daily flat rate tariff and knew their rate, but they didn't know how much power they consumed in a day. They also knew that they were paying different amounts to their neighbours, but did not know how much power their neighbours consumed. Beyond these things, if they wanted further information they had to call the site agent or the field operative directly.

The interviews provided initial insights into how energy can help generate business value; however they did not reflect energy consumption in other spheres and were limited in terms of demographics. Interviews conducted were focused on those who were considered by the company as successful energy users and who could communicate easily in English and were seen as able to understand the research and therefore to participate in it. They were also predominantly male. These limitations were addressed in the design and application of probes that were used in the second visit.

Mageta is also a place where many companies have carried out surveys to understand the successful implementation of the mini-grid. Indeed there was some degree of interview fatigue among staff and customers. As identified by Brereton et al (2014) indigenous communities are relatively wary of being the subject of research. Mageta seems to be Steama.co's 'model' site for understanding usage of mini-grids, and is explored by a variety of organisations and researchers with different objectives. Steama.co's field operative indicated that there are people coming to visit to observe the mini-grid, make films, conduct interviews, do research and more every two to three weeks. The application of probes would introduce something new in this context.

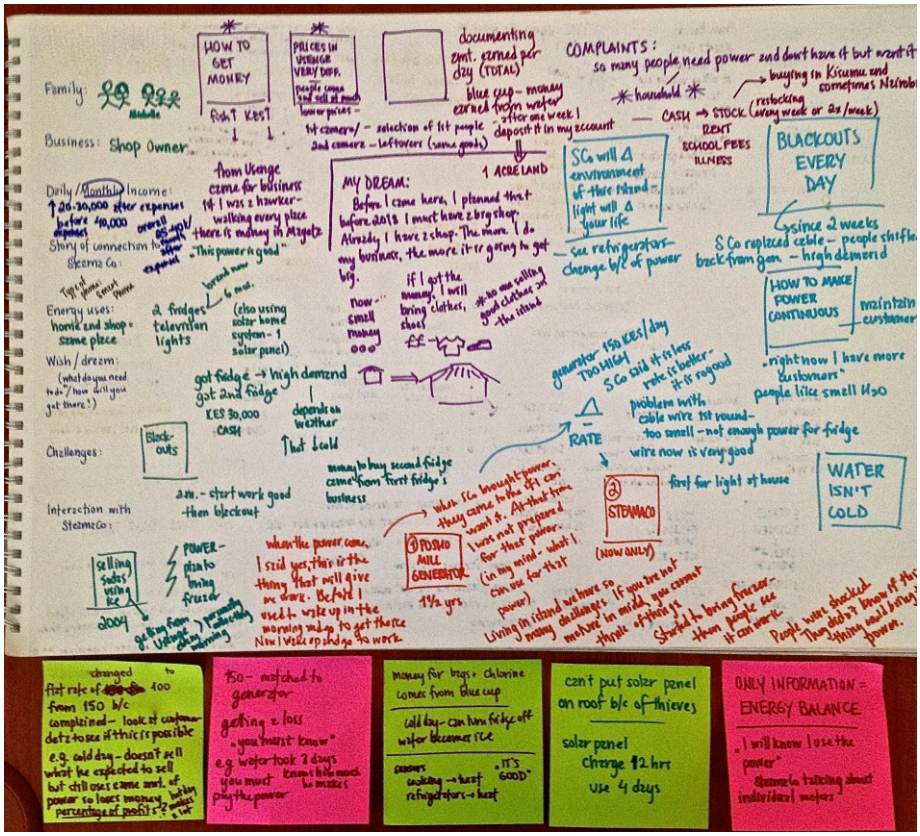

Figure 3. Illustration of interview data

3.2 Second visit: probes

For the second visit we designed two probes to explore value beyond businesses stories. In particular we wanted to understand:

- how people experience and understand their energy usage;
- how they value different appliances, in which context, and how these values are mediated by those who use particular appliances;
- how people understand their own energy consumption, particularly in terms of individual appliances;
- how people understand the value of different services and businesses;
- how values would change if limitations of energy availability were added or removed, in scenarios of scarcity and abundance of energy; and
- how people imagine their personal and communal futures in relation to energy.

The probes were designed to be used in individual interviews as well as in group activities. Despite being the support for interviews, they should be sustained by themselves. They should be straightforward and visual. Interviewers would give verbal directions, ask questions and document responses. Most importantly they should allow active engagement for participants to design their own representations and stories. We finally opted for using stickers and large sheets of paper, where people would build one diagram of appliances and one map of services. Stickers were removable and could be replaced if participants changed their minds.

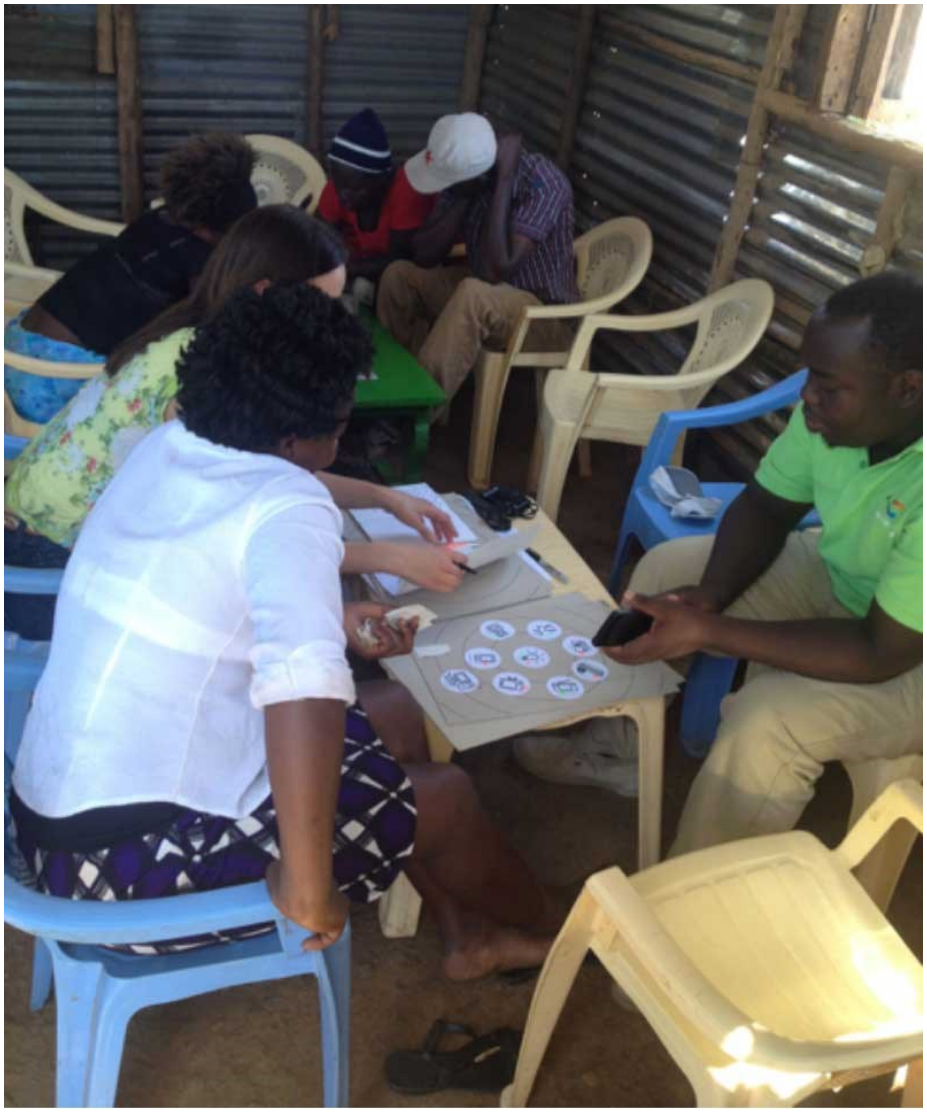

Figure 4. Application of probes

3.2.1 Diagram of appliances

The first probe focused on appliances, the values they mediate, context of usage, awareness of consumption, and appliances participants would like to have in the future (b, c and f above). Based on devices observed in the first visit, and in conversation with the field operative of the partner company, we designed 16 stickers: lamp, mobile phone, laptop, computer, desk lamp, blow dryer, DVD player, electric razor, TV, speakers, router, radio, refrigerator, hand-held video device (a small device with a USB port that can play music and movies), music system (effectively an integrated radio, cassette and CD player and speakers) and video system (a connected system of monitor, DVD player and speakers).

The paper sheet where participants would place these stickers had a diagram of concentric circles that represented increasing levels of importance. Participants were asked to place the most important appliance in the centre of the diagram and then distribute other appliances according to their level of importance, with more important ones towards the centre and less important ones towards the edges.

They were then asked to mark which ones they used at home, which ones they had (if they were a business owner) or would use in a business (if they were not a business owner), which appliances they felt were missing from the diagram, and which ones they would like to have in the future. Stickers with human figures were designed, and participants were asked to place them on the paper

sheet to represent different relationships, and to draw lines to indicate which appliances were used by themselves and which were used by other people. They were finally asked to rank appliances in terms of consumption. Throughout the exercise, they were asked about their motives to place different stickers on the diagram, to draw connections on it and to rank appliances.

3.2.2 Map of services, infrastructure and productive activities

The second probe focused on services and business (d, e and f above). We designed 21 stickers containing services and infrastructure elements. Five were non-profit-making services or institutions - church, home, school, health centre and water. Two, agriculture and fishing, illustrated businesses that are not necessarily reliant on electricity. Eleven corresponded to businesses that we observed in our first visit, and which tended to use power in some way - restaurant, hotel, bar, barber shop, hair salon, music download, download, phone charging, shop, video hall and M-Pesa shop. M-Pesa is the Kenyan mobile money service, and M-Pesa agents manage cash deposits and withdrawals. Internet cafe and shop were future business ideas, as there was no consistent Internet data connection on the island. We also included a sticker representing power itself.

Participants were asked to place the services on the map according to which services they thought were most important for the island, following a general idea of concentric circles, placing the most important service in the centre of the map and expanding outward from there. They were asked if any services were missing from our sticker set and if so, to identify which services we had failed to consider.

After participants had placed all the stickers, we asked them which service they would choose if they could only provide power to one of them. A small sticker with '1' was placed on this service. We then asked them to rank the remaining services in order of preference in terms of distributing power. Based on their responses, they placed additional numbered stickers on the services, from '2' upward. Responses varied among participants; some only ranked a few services while others ranked all of them.

Both probe exercises took from 15 to 40 minutes from each participant, with an average of 20 minutes. Both probe exercises were carried out with 25 participants - 14 adults and 11 high school students. Of these, 12 were female and 13 were male. Six of the adults ran businesses that depended on energy (e.g. mobile phone charging shop), four ran businesses that did not rely on energy, and of the others one was employed as a shop assistant, 2 were fishermen and one was a housewife.

3.3 Probe responses

The stickers and method of ranking by concentric circles were straightforward. The visual medium and the interaction provided by the probes helped to mediate conversation, while raising curiosity. Probes gave participants some degree of freedom in relation to traditional questionnaires. Most carefully selected which appliances they placed on the diagram: "I understand that these appliances exist but I don't want to place them here" (P2). Other participants chose more than one sticker to place in the centre, explaining that ranking one higher would make little sense since they were highly valued in different contexts.

3.3.1 Degree of importance of appliances

Appliances that were placed more often in the diagram, and which were also placed most closely to the centre of the diagram were: 1) lamp, 2) mobile phone, 3) TV, 4) refrigerator. These were strongly related to the ones that were most often owned by participants: 1) lamp, 2) mobile phone, 3) TV, 4) radio. A second group of appliances given a high degree of importance included: DVD system, computer, laptop, music system, speakers, and video system. All other appliances were chosen 5 times or less. The students demonstrated higher awareness of computers than others. Highest ranked appliances in terms of importance among students were: 1) lamp, computer, mobile phone, refrigerator. Appliances that appeared most often in the diagram were the same as in the adult

group. When looking at single appliances that were most often placed in the centre of the diagram, lamp was placed 11 times by adult participants and 8 times by students, followed by computers chosen by 2 adult participants and 3 students, and electric razor, chosen by 3 adult participants.

3.3.2 Future appliances

Top future appliances among adults were: 1) refrigerator (chosen 8 times), 2) video system (chosen 5 times, taking into account both business and the home), 3) blow dryer, electric razor, computer, music system, and TV (all chosen 4 times). Here there were a few differences in responses given by men and women. While both considered future appliances in the context of businesses, a few women also considered future appliances in the context of the home. Three of them suggested that they would like a blow dryer in order to open a hair salon. As mentioned earlier, hair salons were indeed rare in the Island, particularly when compared with barber shops. While most appliances placed on the diagrams were reported to be used at home, most future ones were considered in the context of expanding or considering new sources of income (e.g. a computer would allow participants to start a music download service, for example).

3.3.3 Appliances: level of consumption

Participants were asked to rank appliances in relation to their power consumption. Previous research (e.g. Lockton et al, 2013) demonstrates that people have little knowledge of how much their appliances consume overall. Rather than testing if participants knew how much energy their appliances consumed, the ranking exercise was meant to trigger reflection on how much they have been, would be willing to or imagined paying for using each device.

Top ranked appliances were: TV, refrigerator, lamp, computer, and mobile phone. Choices were influenced by: 1) frequency of usage of different appliances " [Computer] You can switch off a fridge but a computer is running all the time" (P3) 2) knowledge of wattage "Refrigerator needs a lot of power" (P13), and 3) the number of tasks performed by an appliance "Laptop does a lot of things, download music, plays music..." (P4) "Because I use it [mobile phone] in different ways. For light and music, for example." (P7)

Appliances chosen as highest in consumption were refrigerator (chosen by 5 participants) and computer (chosen by 3 participants). All other appliances were chosen first only once. Among students, appliances that were ranked highest in terms of consumption were: 1) computer, 2) TV, 3) lamp, 4) refrigerator, 5) blow dryer.

Figure 5. P8's probes: Indicating importance of appliances in the dia- gram and illustrating the importance of water in the services map

3.3.4 Services, infrastructure, and productive activities in Mageta: degree of importance

The lack of pre-defined structure of the map sheets allowed participants to creatively express the importance of services. Often they would just say which they thought were the most important services/activities. Other times they would attempt to illustrate this importance through the arrangement of stickers (see Figure 1). When asked about the degree of importance of different services, participants ranked services that are in the heart of community interests consistently high. Fishing, the main productive activity in the island, was ranked highest, followed by health centre (2), school (3), church (4), and shop (5). Among students, highest rated activities/services in terms of importance were 1) health centre and home, 2) agriculture, 3) school, and 4) fishing.

Considering activities that adult participants chose first, fishing which is central to the island was the only activity chosen more than once (6 times). Other activities chosen only once were: power (P3), health centre (P4), school (P5), home (P6), water (P8), phone charging (P10), barber shop (P12), church (P13). Often, this second choice related to their personal stories (e.g. of sickness), interests

(e.g. the importance of the barber shop), or energy solutions for their personal issues, e.g. water pump to irrigate crops.

3.3.5 Energy supply rank

When asked about services that they would like to provide power to, the top 5 choices among adult participants were 1) health centre, 2) school, 3) phone charging, 4) home, and 5) shop. Home appeared more often in the energy supply context than in the rank of importance. Students would provide energy to similar services/activities choosing the following activities as top 5: 1) school, 2) health centre, 3) phone charging, 4) home, and 5) restaurant. The activity chosen most often among adults was phone charging (which was nevertheless ranked differently in each diagram), and among students it was school, which reflected the importance as well as time spent using these services.

Overall these energy supply choices were influenced by 1) importance for the community, 2) participants' own experience of using energy in different services, 3) thoughts about which services needed light bulbs rather than supply of other sorts of devices, and 4) personal preference. While most participants focused on communal activities when considering the importance of services, personal interests played a bigger role in the power supply-ranking task.

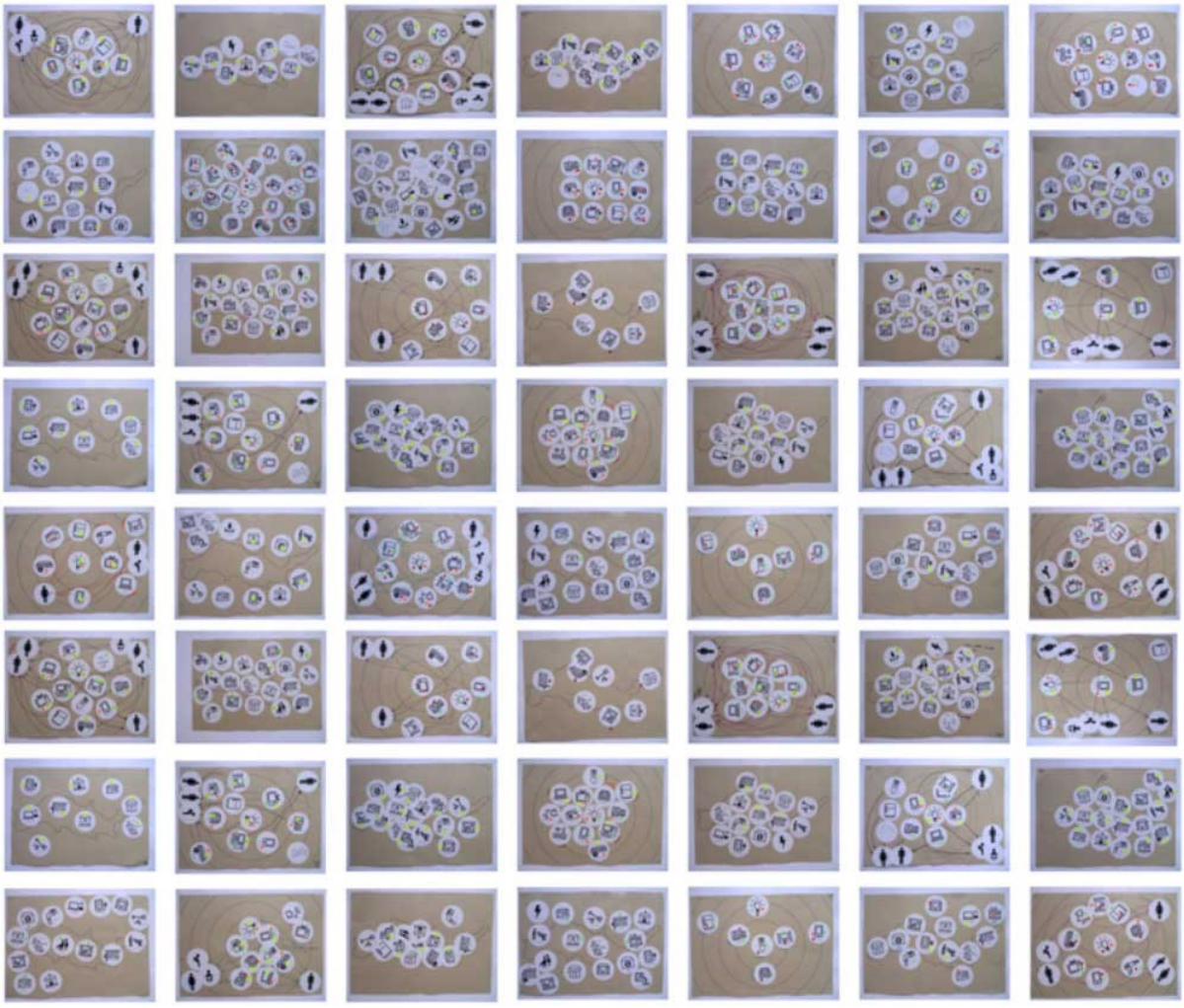

Figure 6. Overview of collected probes

4 Reflections

4.1.1 Reflections on the probe method

The probes provided a tactile, more concrete way to quickly approach participants. Lowering barriers to engage participants, it allowed us to speak to participants of more varied backgrounds, including women and school students, and those who were not direct customers of the partner company or were not seen as potential business owners.

The probes were more suitable to support a conversation around values than traditional questionnaire methods would be. They allowed for more ambiguity and therefore more reflection on the subject at hand. The freedom of placing and repositioning stickers on the map or diagram allowed participants to reflect on what these appliances and services meant. Instead of passively answering questions, they could visualise, define and change the stickers to create their own maps and stories.

Prone to incite curiosity, the probes also invited the opinion of others. Family members, colleagues, and passer-bys would give participants ideas and suggestions on what to place on the map, making it into an instrument of conversation. Finally, it was of great importance that the probes were not simply sent to participants but were used as a starting point for conversation.

4.1.2 Boundaries between home and business and need for appliances

The study drew attention to how boundaries between home and businesses are less defined than often assumed. Electrical appliances used for domestic entertainment were sometimes considered as a way to supplement income. Domestic music systems were hired for community events; refrigerators were desired both to keep food fresh at home and to enable participants to sell cold drinks. Video systems were considered both for opening a video hall and for personal entertainment.

The study also raised discussion regarding the ability of appliances to generate monetary value. Mahanga Beach is characterised by an unusually entertainment-driven culture as a result of the relatively high cash flows brought in through fishing. Talking about the potential of music systems, P1 mentioned: “Most people like music. If you don’t have power, you have no music, and people just go away.” However, while there were already many businesses created based on off-the-shelf appliances, such as barbershops and video halls, new appliance-based businesses would not necessarily guarantee greater income, especially if the owner required a loan to buy appliances to support his or her business. Some participants were indeed critical of the model of value creation through appliances: “Appliances are not essential for a business.” There was a tension between appliances being considered necessary for businesses and gaining customers and the costs incurred in buying and running these appliances. Following energy ladder narratives, which were disseminated not only through energy but also loan and other technology companies, owning appliances still symbolised wealth, and these were desired by most participants.

4.1.3 Values influencing interpretations of energy needs

The results showed general trends toward giving high importance to community services. Oftentimes however, choices were made that represented a certain aspect of the participant personality or belief, which would turn into a conversation point. P7 for instance chose the following options as the most important services in Mageta: 1) fishing 2) school 3) health centre 4) M-Pesa and 5) phone charging. These were services of high importance in Mageta. The participant, however, would opt to supply energy to the Church first because “it deserves”. She was aware that the Church needed less power than other services, and putting the Church in a position of privilege supported her identity as a religious person. P7 also made sure to stress that “Bar” would be her last choice. P6 on the other hand placed home in the centre of the map stating that, “Everyone needs a home, this is where everything starts”. Rather than a necessity, providing energy to a particular service or place was a symbolic gesture of placing this service above others, literally giving power to it.

4.1.4 Communal vs. individual interests

There was some degree of overlap in appliances that people placed in the centre of the map and the services that they prioritised for energy allocation. Most often, however, participants would rank communal services of high importance, to show how much they cared about these services. This ranking was occasionally in contrast to their decision to allocate power to services. In this case, they would prioritise businesses they depended on or personally valued the most, either their own businesses or businesses they frequented more often. For example, P1 placed fishing, church and health centre in the centre of his services map; however, his ranking of energy allocation included downloading, video room and barber shop. Energy-dependent business owners particularly valued their own use of energy over communal ones. P1 explained the motivations for placing lamp, video system, computer, and electric razor in the centre of the appliances diagram: video system and computer referred to P1's own businesses, and electric razor was one of the appliances that he planned to buy in order to start a new barber shop.

4.1.5 Implications for research for design

The reflections above demonstrate the complexity of values that are linked to narratives of development based on energy-supported businesses. From these reflections we draw three main recommendations for considerations in research for design.

a) Ambiguity. The value of ambiguity in design has been largely discussed by Gaver et el. (2003). Here we argue for the integration of ambiguity in the application of methods to explore values. Values are messy and linked to issues beyond the visible and describable, which makes each context unique. Welcoming ambiguity in the application of methods therefore opens up space to embrace such nuances. Open methods allow participants to introduce new themes and conflicting points-of-view, which helps to reveal values that were concealed by what is often considered the "right answer". While many discourses of energy implementation focus on objective needs of a particular community, participants tended to choose services that they personally valued most. In other words, the choice to provide power to different services was strongly connected to a sense of value and emotional attachment, rather than objective considerations. A less open method of structured interviews and questionnaires would probably only identify such issues if set as a hypothesis beforehand.

b) Contextual awareness. In line with Pink et al, this study demonstrates the importance of understanding appliances in context. This is particularly important in developing contexts. Here too ambiguity can play an important role. Rather than trying to strictly define their use, designers can leave value to be defined in the usage.

c) Beyond narratives of development. Rather than looking at narratives of development and energy ladders, we should consider profit models within broader forces of value. It is important to understand commercial motives behind narratives around the introduction of appliances in developing contexts, attempting to explore alternative models.

4.1.6 Limitations of the study and future work

It is important to stress that this study was strongly situated. It focused on one form of provision, a solar mini-grid, and on a small island. The study location was chosen in part for its representation of an extreme situation. The aim of reporting the study was to communicate the potential of applying specific methods to study energy rather than to offer a representative analysis of the larger population of off-grid energy users.

Both visits were carried out in a very short period of time. Extra time would be necessary to gain a deeper understanding of this community. In addition, some people who we had expected to follow up with from the first visit were not available in the second.

5 Conclusion

This study gave us the opportunity to explore people's values around energy in a way that reflected the nuances, complications and conflicts of lived experience. The probes allowed the opening up of space for ambiguity, which highlighted that people's priorities and uses of energy will not necessarily follow assumptions about economically driven decisions. As male and female, business owner and housewife, parent and student, micro-grid customer and unelectrified, their current and future relationships with energy are influenced by their roles and structured surroundings. Those supporting the expansion of energy access can take note as they design systems that will be required to serve a diversity of users and where the systems may shape users' values even as they are shaped by them.

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